

Remarks

The Applicants note with appreciation the Examiner's acknowledgment of consideration of the Information Disclosure Statements.

The Applicants acknowledge the objection to Claim 1 with respect to the sialon content. The Applicants have cancelled Claim 1 and rewritten it as new Claim 17. New Claim 17 contains additional language that makes the sialon content clear. Withdrawal of the objection is respectfully requested.

The Applicants acknowledge the rejection of Claim 13 under 35 U.S.C. §112 as being indefinite. The Applicants note with appreciation the Examiner's helpful comments concerning the dependency of Claim 13 on Claims 7 and 8 with respect to a nitrogen gas atmosphere in Claim 13 being different from the nitrogen-containing inert gas atmosphere. Claim 13 has been rewritten as new Claim 32. In any event, the Applicants respectfully submit that Claim 32 properly depends from Claims 7 and 8, which have been rewritten as Claims 26 and 27. This is because nitrogen is an inert gas and an inert gas is different from a rare gas. Withdrawal of the 35 U.S.C. §112 rejection is accordingly respectfully requested.

The Applicants acknowledge the rejection of Claims 1, 3 – 5, 15 and 16 under 35 U.S.C. §103 over US '379. That rejection is technically moot in view of the cancellation of those claims. They have, however, been rewritten as Claims 17, 22 – 24, 34 and 35. Nonetheless, the Applicants respectfully submit that those claims are patentable over US '379 for the reasons set forth in detail below.

US '379 mentions a compositional formula of sialon activated by Eu: $\text{Me}_{p/2}\text{Si}_{12-(p+q)}\text{Al}_{(p+q)}\text{O}_q\text{N}_{16-q}:\text{Eu}^{2+}$, where q is 0 – 2.5 and 0.5 – 3. However, this is only a general compositional formula of α -sialon and it is not applicable.

US ‘379 is different for at least the following reasons:

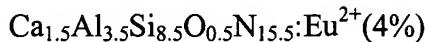
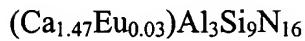
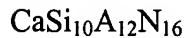
(1) The Official Action helpfully observes that the formula appearing in US ‘379 shows that the phosphor is composed of 100% α -sialon. However, this is not the case. Those skilled in the art know that, even if the composition is the same, it is by no means certain that only a single α -sialon phase is detected by powder X-ray diffraction. The content of the crystal phase must be determined by X-ray diffraction. The chemical formula of US ‘379 does not assure that the phosphor of US ‘379 is composed of 100% α -sialon. Thus, the applicability of US ‘379 is speculative at best.

In Claim 17, it is possible to produce a powder containing a high content, even 90% or more, of α -sialon phase by using as the starting raw material an amorphous Si_3N_4 having a controlled oxygen content. Without taking this specific measure, it is not possible to produce a powder containing such a high content of α -sialon phase. In the prior art, a hot press is required to obtain a high α -sialon content. It is important to note, however, that such a process results in a compact body, not a powder as recited in Claim 17.

(2) Chemical composition is substantially different:

In US ‘379, Column 7, in Claim 3, it is mentioned that $q < 1$ and/or $p = 2 \sim 3$. Claim 1 states “According to the invention, the phosphor used for the LED-based illumination unit is a sialon which emits yellow-orange and originates from the class of the Eu-activated sialons, the sialon corresponding to the formula $M_{p/2}\text{Si}_{2-p-q}\text{Al}_{p+q}\text{O}_q\text{N}_{16-q}:\text{Eu}^{2+}$, where $M = \text{Ca}$ individually or in combination with Sr and Mg , where $q = 0$ to 2.5 and $p = 0.5$ to 3. It is preferable to select a high value for p , specifically $p = 2$ to 3, and a relatively low value for q , specifically $q = 0$ to 1.”

Further, the following chemical compositions of sialon are shown in the Examples of US ‘379:



The descriptions of the above chemical compositions (Column 4, line 26 to Column 5, line 25 and the Examples) are limited to a composition in which the oxygen concentration is very low.

In sharp contrast, the α -sialon of Claim 17 is represented by the general formula: $M_x\text{Si}_{12-(m+n)}\text{Al}_{(m+n)}\text{O}_n\text{N}_{16-n}:\text{Ln}_y$, wherein $0.3 \leq x+y < 1.5$, $0 < y < 0.7$, $0.3 \leq m < 4.5$, $0 < n < 2.5$, and $m = (ax + by)$, assuming that the atomic valence of the metal M is a and the atomic valence of the lanthanide element La is b, and from the Examples and Comparative Examples (see above Tables 11 to 14), it can be seen that the α -sialon is characterized by $1.1 < n < 2.0$ and $0.3 \leq x+y < 0.94$ (new Claim 17), which corresponds to $q > 1.1$ and $p < 1.88$ as expressed by the method of US '379. These ranges are different from $p=2$ to 3 and $q=0$ to 1 of US '379.

Since the chemical compositions are different, the materials are also different from US '379.

The above difference of the chemical composition is derived from the very high purity (0.01 wt% or less of the metal impurity) of Claim 17.

(3) The purity is different.

Claim 17 relates to an α -sialon-based oxynitride phosphor powder characterized in that the content of metal impurities is 0.01 wt% or less.

US ‘379 mentions “high-purity starting material” in Column 5. However, that description is not sufficient to specify the final impurity concentration. There are no descriptions of the product names or even the manufacturer’s names of the materials used, which makes it difficult to assume the purities of the material. There is also no description of the purity of the produced α -sialon.

The expression “high-purity starting material” in and of itself does not assure that the total content of the metal impurities in the α -sialon is 0.0 wt% or less.

(4) The oxygen content is very different.

In US ‘379, the highest oxygen content is 1.28 wt%, calculated from the highest oxygen-containing composition $\text{Ca}_{1.5}\text{Al}_{3.5}\text{Si}_{8.5}\text{O}_{0.5}\text{N}_{15.5}:\text{Eu}^{2+}$ (4%), which is far lower than the range of 3.1 wt% or more of Claim 18.

Paragraph (0026) of the Applicants’ Specification discloses that, by controlling the oxygen content of amorphous Si_3N_4 as the starting material to be in a range of 1 to 5 wt%, preferably 1.1 to 3 wt%, the oxygen content of the produced α -sialon powder becomes 3.1 wt% or more. If the oxygen content of α -sialon powder is less than 3.1 wt%, the content of α -sialon in the product decreases, which is disadvantageous.

In this respect, i.e., controlling the content of α -sialon by the oxygen content, US ‘379 is not applicable. If the oxygen content is less than 3.1 wt%, it is difficult to synthesize α -sialon having a high content of α -sialon as in Claim 17.

Furthermore, another characteristic feature of Claim 17 resides in the excess oxygen. When the sialon is expressed as $M_xSi_{12-(m+n)}Al_{(m+n)}O_nN_{16-n}:Ln_y$, wherein $0.3 \leq x+y < 1.5$, $0 < y < 0.7$, $0.3 \leq m < 4.5$, $0 < n < 2.5$, and $m = (ax + by)$, assuming that the atomic valence of the metal is a and the atomic valence of the lanthanide element is b, the excess oxygen means the difference between the measured oxygen content of the synthesized sialon and the oxygen content in the compositional formula $(M_x, Ln_y)Si_{12-(m+n)}Al_{(m+n)}O_{ax/2+by/2}N_{16-(ax/2+by/2)}$ in which metal M and lanthanide element Ln are added as $MO_{a/2}$ and $LnO_{b/2}$, and is a value in wt% converted from the oxygen content of $n-(ax/2+by/2)$ in the above formula.

Paragraph (0032) of the Applicants' Specification discloses that the content of α -sialon is increased by adding an excess oxygen of 2.5 wt% or less, preferably 2.0 wt% or less to the theoretical α -sialon composition. Tables 2, 4, 7 and 9 of the Applicants' Specification show the excess oxygen contents (wt%) which are in a range of 0.8 to 2.3 wt%.

When the Examples are compared to Comparative Examples 4 and 5 or with Comparative Examples 101 and 102, it is seen that the content of α -sialon decreases if the excess oxygen content is too low (0.7 wt% or 0.6 wt%) or too high (4.1 wt% or 4.0 wt%).

It is clear that controlling the sialon composition by the content of excess oxygen also makes US '379 inapplicable.

(5) US '379 is also essentially different in crystal phase contents, purity, chemical composition and oxygen content.

The Applicants therefore respectfully submit that Claims 17, 22 – 24, 34 and 35 are patentable over US '379. Withdrawal of the rejection is respectfully requested.

The Applicants acknowledge the rejection of Claim 6 under 35 U.S.C. §103 over the hypothetical combination of US '861 with US '379. Again, that rejection is technically moot in

view of the cancellation of Claim 6. Claim 6 has been rewritten as new Claim 25 and the Applicants respectfully submit that the hypothetical combination, even if made, would still fail to teach or suggest the subject matter of new Claim 25. In particular, the α -sialon of Claim 25 is different from US ‘861 in several ways. First, Claim 25 recites that the degree of dispersion d_{90}/d_{10} is 7 or less.

US ‘861 mentions in the Abstract, Column 2 and Column 5 the following:

“The luminous substance is a phosphorous group of the general formula A.sub.3 B.sub.5 X.sub.12:M, and the luminous substance pigments have particle sizes <20 .mu.m and a mean grain diameter d.sub.50 <5 .mu.m.”

“an inorganic luminous substance pigment powder dispersed in the transparent epoxy resin, the pigment powder comprising luminous substance pigments from a phosphorous group having the general formula A.sub.3 B.sub.5 X.sub.12:M; The luminous substance pigments having grain sizes. \leq 20 .mu.m and a mean grain diameter d.sub.50 . \leq 5 .mu.m.”

“a wavelength-converting casting composition disposed in a vicinity of the semiconductor body, the casting composition being formed of a transparent epoxy casting resin and an inorganic luminous substance pigment powder dispersed in the transparent epoxy resin, the pigment powder comprising luminous substance pigments from a phosphorus group having the general formula A.sub.3 B.sub.5 X.sub.12:M and having grain sizes. \leq 20 .mu.m and a mean grain diameter d.sub.50 . \leq 5 .mu.m;”

However, US ‘861 discloses only grain size and mean grain size, which does not disclose the degree of dispersion at all, and does not relate to an α -sialon-based oxynitride phosphor powder. In sharp contrast, Claim 25 is characterized by an α -sialon-based oxynitride phosphor powder, wherein in the particle size distribution curve, the degree of dispersion expressed by

d_{90}/d_{10} is 7 or less. Thus, US '861 does not teach or suggest the subject matter of Claim 25 at all. Accordingly, even if one of ordinary skill in the art were to hypothetically combine US '861 with US '379, the resulting powder would still fail to teach or suggest the subject matter of Claim 25. Withdrawal of the rejection is respectfully requested.

The Applicants have already noted the cancellation and rewriting of various of the claims. All of original Claims 1 – 16 have been cancelled in favor of new Claims 17 and 21 – 35, respectively. New Claims 18, 19 and 20 are, in fact, new claims and the Applicants respectfully request examination on the merits. A number of the new claims merely contain changes directed to form in accordance with U.S. Rules of Practice. However, new Claims 24 and 25, substantially corresponding to original Claims 5 and 6, include additional subject matter. Support may be found throughout the Applicants' Specification, such as in the text spanning pages 10 and 11, for example.

In light of the foregoing, the Applicants respectfully submit that the entire Application is now in condition for allowance, which is respectfully requested. To the extent that the Examiner believes that a discussion with the Applicants' representative would be helpful in resolving any minor additional issues, the Applicants respectfully request a discussion with the Examiner at the Examiner's convenience.

Respectfully submitted,



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